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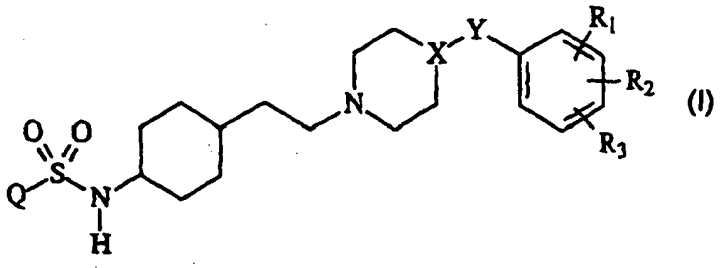
(54) Title: NEW SULFONAMIDE DERIVATIVES AS D3-RECEPTOR AGONISTS



(I)

(57) Abstract: The present invention relates to new D_3 dopamine receptor subtype selectice ligands of formula (I) to pharmacological compositions containing the same and to their us in therapy and/or prevention of psychoses (*e.g.* schizophrenia, schizo-affective disorders, *etc*), drug (*e.g* alcohol, cocaine and nicotine, opioids *etc.*) abuse, cognitive impairment accompanying schizophrenia, mild-to-moderate cognitive deficits, amnesia, eating disorders (*e.g* bulimia nervosa, *etc.*), attention deficit disorders, hyperactivity disorders in children, psychotic depression, mania, paranoid and delusional disorders, dyskinetic disorders (e.g. Parkinson's diseases, neuroleptic induced Parkinson's desases, tardive dyskinesias) anxiety, sexual dysfunction, sleep disorders, emesis, aggression, autism, pain ophthalmological diseases (*e g* glaucoma *etc*).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

NEW SULFONAMIDE DERIVATIVES AS D3-RECEPTOR AGONISTS

Field of the invention

The present invention relates to new D_3 dopamine receptor subtype selective ligands of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof which are useful in the therapy and/or prevention of psychoses (*e.g.* schizophrenia, schizo-affective disorders, *etc.*) and other central nervous system and ophthalmological disorders. The present invention also relates to the processes for producing compounds of formula (I) and to pharmacological compositions containing the same.

Description of the prior art

PCT Patent Publication WO 98/50364 describes tetrahydroisoquinoline derivatives which have affinity for dopamine receptors and useful as antipsychotic agents.

PCT Patent Publication WO 97/45403 discloses aryl substituted cyclic amines as selective dopamine D_3 ligands.

German Patent Publication DE 19728996 describes triazol derivatives. The compounds are said to be dopamine D_3 receptor antagonists and/or agonists useful for the treatment of central nervous system disorders *e.g.* Parkinson's disease or schizophrenia.

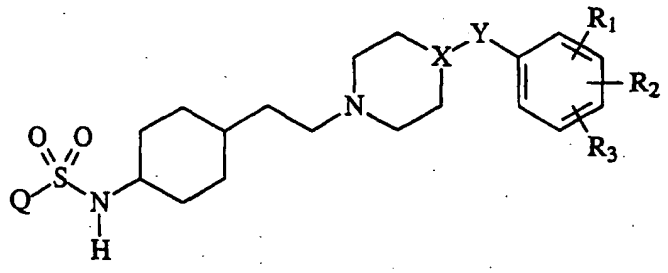
Although the compounds mentioned in the above publications have affinity for dopamine D_3 receptors, their chemical structures differ from the structure of compounds of the present invention.

Summary of the invention

We have found a class of sulfonamide derivatives which have high affinity for dopamine D_3 receptors and selectivity over other receptors, especially dopamine D_2.

The selectivity is particularly important as the undesired side effects of the compounds are much less pronounced.

The present invention relates to new D_3 dopamine receptor subtype selective ligands having sulfonamide structures of formula (I)



(I)

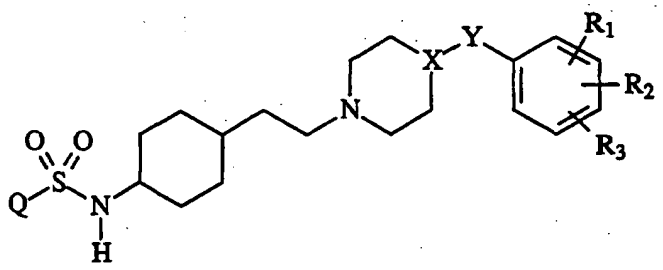
- wherein
  - X represents a nitrogen atom or CH group;
  - Y represents a bond when X stands for nitrogen, or an oxygen atom or NH or CH_2 or OCH_2 group when X stands for CH group;
  - R_1, R_2, R_3 may be the same or different and represent independently a substituent selected from hydrogen, halogen, C_{1-6}-alkyl, C_{1-6} alkoxy, cyano, hydroxy, trifluoromethyl, C_{1-6}-alkylsulfonyloxy, trifluoromethanesulfonyloxy, C_{1-6}-alkanoyloxy, amino, alkylamino, alkanoylamino, alkylsulfonylamino, arylsulfonylamino, aminocarbonyl, carboxy, N-hydroxycarmamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl, sulfamoyl, mono or bicyclic heterocyclic group or optionally substituted phenyl, or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
  - Q represents an optionally substituted alkyl, aryl, aralkyl or heteroaralkyl group

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof, to the processes for producing the same, to the pharmacological compositions containing the same and their use in therapy and/or prevention of psychoses (*e.g.* schizophrenia, schizo-affective disorders, *etc.*), drug (*e.g.* alcohol, cocaine and nicotine, opioids *etc.*) abuse, cognitive impairment accompanying schizophrenia, mild-to-moderate cognitive deficits, amnesia, eating

disorders (*e.g.* bulimia nervosa, *etc.*), attention deficit disorders, hyperactivity disorders in children, psychotic depression, mania, paranoid and delusional disorders, dyskinetic disorders (*e.g.* Parkinson's disease, neuroleptic induced Parkinsonism, tardive dyskinesias) anxiety, sexual dysfunction, sleep disorders, emesis, aggression, autism, pain, ophthalmological diseases (*e.g.* glaucoma *etc.*).

Detailed description of the invention

The present invention relates to new compounds of formula (I)



(I)

- wherein
  - X represents a nitrogen atom or CH group;
  - Y represents a bond when X stands for nitrogen, or an oxygen atom or NH or CH_2 or OCH_2 group when X stands for CH group;
  - R_1, R_2, R_3 may be the same or different and represent independently a substituent selected from hydrogen, halogen, C_{1-6}-alkyl, C_{1-6} alkoxy, cyano, hydroxy, trifluoromethyl, C_{1-6}-alkylsulfonyloxy, trifluoromethanesulfonyloxy, C_{1-6}-alkanoyloxy, amino, alkylamino, alkanoylamino, alkylsulfonylamino, arylsulfonylamino, aminocarbonyl, carboxy, N-hydroxycarmamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl, sulfamoyl, mono or bicyclic heterocyclic group or optionally substituted phenyl, or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
  - Q represents an optionally substituted C_{1-6}-alkyl, aryl, heteroaryl, aralkyl or heteroaralkyl group

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

When Q represents aryl, the aryl moiety may be selected from an optionally substituted mono- or bicyclic aryl namely phenyl or naphthyl group.

A heteroaryl ring in the meaning of Q may be monocyclic or bicyclic ring.

The monocyclic heteroaryl ring may be an optionally substituted 5- or 6-membered aromatic heterocyclic group containing 1 to 4 heteroatoms selected from O, N or S.

Examples of 5- and 6-membered heterocyclic groups include furyl, thienyl, pyrrolyl, oxazolyl, thiazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, pyridyl, triazolyl, triazinyl, pyridazyl, pyrimidinyl, isothiazolyl, isoxazolyl, pyrazinyl and pyrazolyl, preferably pyridyl and thienyl.

Examples of bicyclic heteroaromatic groups include indazolyl, indolyl, benzofuranyl, benzothienyl, benzothiazolyl, benzimidazolyl, benzoxazolyl, benzisoxazolyl, benzisothiazolyl, quinolinyl, quinoxolinyl, quinazolinyl, cinnolinyl or isoquinolinyl, preferably quinolinyl, benzofuranyl, benzothiophenyl, benzthiazolyl, benzimidazolyl and indolyl group.

The substituents of substituted C_{1-6}-alkyl, aryl, heteroaryl, aralkyl or heteroaralkyl groups in the meaning of Q are selected from hydrogen, halogen, cyano, trifluoromethyl, C_{1-6}-alkyl, C_{1-6}-alkoxy, C_{1-6}-alkanoyl, methylenedioxy, C_{1-6}-alkylamino, C_{1-6}-alkanoylamino, optionally substituted aroyl, aryloxy, aminosulfonyl, arylsulfonylamido, optionally substituted mono or bicyclic aromatic or heteroaromatic ring, wherein the aryl may have the same meaning as mentioned above.

The substituents of C_{1-6}-alkanoyloxy in the meaning of R_1, R_2 and R_3 are selected from hydrogen or halogen.

The amino, aminoalkyl, aminocarbonyl, N-hydroxycarbamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl and sulfamoyl groups in the meaning of R_1, R_2 and R_3 may optionally be substituted on the N atom.

The mono or bicyclic heterocyclic group in the meaning of R_1, R_2 and R_3 may be saturated or unsaturated containing 1 to 4 heteroatoms selected from O, N or S.

In the compounds of formula (I) an alkyl group or moiety in alkoxy, alkanoyl, alkanoylamino, alkanoyloxy groups may be straight or branched included methyl,

ethyl, *n*-propyl, *n*-butyl, *n*-pentyl-, *n*-hexyl and branched isomers thereof such as isopropyl, *t*-butyl, *sec*-butyl, and the like.

The halogen substituent(s) in the compounds of formula (I) may be fluorine, chlorine, bromine or iodine, preferably fluorine, bromine and chlorine.

The compounds of formula (I) can exist in the form of *cis*- and *trans*-isomers with respect to the configuration of the cyclohexane ring. These and their mixtures are likewise within the scope of the present invention. Preferably the compounds of the invention are in the *trans* configuration.

The invention also relates to the salts of compounds of formula (I) formed with acids.

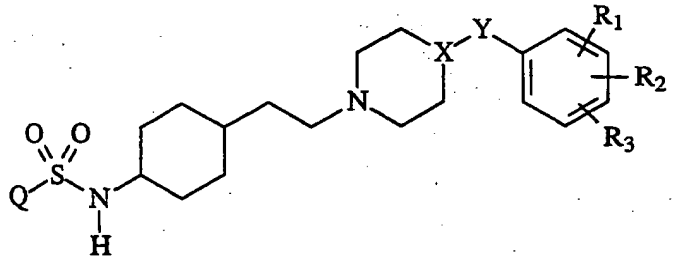
Both organic and inorganic acids can be used for the formation of acid addition salts. Suitable inorganic acids can be for example hydrochloric acid, sulfuric acid, nitric acid and phosphoric acid. Representatives of monovalent organic acids can be for example formic acid, acetic acid, propionic acid, and different butyric acids, valeric acids and capric acids. Representatives of bivalent organic acids can be for example oxalic acid, malonic acid, maleic acid, fumaric acid and succinic acid. Other organic acids can also be used, such as hydroxy acids for example citric acid, tartaric acid, or aromatic carboxylic acids for example benzoic acid or salicylic acid, as well as aliphatic and aromatic sulfonic acids for example methanesulfonic acid, naphtalenesulfonic acid and p-toluenesulfonic acid. Especially valuable group of the acid addition salts is in which the acid component itself is physiologically acceptable and does not have therapeutical effect in the applied dose or it does not have unfavourable influence on the effect of the active ingredient. These acid addition salts are pharmaceutically acceptable acid addition salts. The reason why acid addition salts, which do not belong to the pharmaceutically acceptable acid addition salts belong to the present invention is, that in given case they can be advantageous in the purification and/or isolation of the desired compounds.

Solvates and hydrates of compounds of formula (I) are also included within the scope of the invention.

As the invention relates also to the salts of compounds of formula (I) formed with acids, especially the salts formed with pharmaceutically acceptable acids, the

meaning of compound of formula (I) is either the free base or the salt even if it is not referred separately.

Preferred compounds of the invention are those compounds of formula (I)



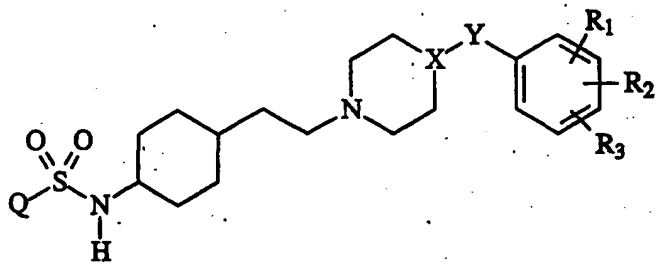
(I)

wherein

- X represents a nitrogen atom or CH group;
- Y represents a bond when X stands for nitrogen, or an oxygen atom or NH or CH_2 or OCH_2 group when X stands for CH group;
- R_1 R_2, R_3 may be the same or different and represent independently hydrogen, alkyl, alkoxy, halogen, cyano, aminocarbonyl, trifluoromethyl, amino, alkylamino, alkanoylamino, alkylsulfonylamino, arylsulfonylamino, aminocarbonyl, carboxy, N-hydroxycarmamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl, sulfamoyl, mono or bicyclic heterocyclic group or optionally substituted phenyl, or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
- Q represents dialkylamino, optionally substituted phenyl, biphenyl, pyridyl, thienyl, alkyl or quinolinyl;

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

Especially preferred compounds of the invention are those compounds of formula (I)



(I)

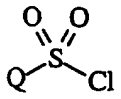
wherein

- X represents a nitrogen atom or CH group;
- Y represents a bond when X stands for nitrogen, or CH_2 group when X stands for CH group;
- R_1, R_2, R_3 may be the same or different and represent independently hydrogen, fluorine, bromine, chlorine atoms or cyano, trifluoromethyl, methyl, methoxy, ethoxy, aminocarbonyl, amino, alkylamino, alkanoylamino, alkylsulfonylamino, arylsulfonylamino, aminocarbonyl, carboxy, N-hydroxycarmamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl, sulfamoyl, mono or bicyclic heterocyclic group or optionally substituted phenyl, or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
- Q represents C_{1-4} alkyl, dimethylamino, biphenyl, alkylphenyl, alkoxyphenyl, halophenyl, nitrophenyl, trifluoromethylphenyl or aminocarbonylmethylphenyl, pyridyl, or quinolinyl;

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

Furthermore subjects of the present invention are the synthesis of compounds of formula (I) and the chemical and pharmaceutical manufacture of medicaments containing these compounds, as well as the process of treatments and/or prevention with these compounds, which means administering to a mammal to be treated - including human - effective amount/amounts of compounds of formula (I) of the present invention as such or as medicament.

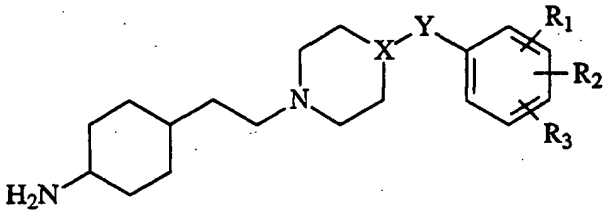
The present invention also provides processes for preparing compounds of formula (I) by forming a sulfonamide bond between a sulfochloride of formula (II) or a derivative thereof



(II)

- wherein the meaning of Q is as described above for the formula (I)

and an amine of formula (III) or a derivative thereof



(III)

- wherein the meaning of R_1, R_2, R_3, X and Y are as described above for the formula (I).

The sulfonamide bond formation may be carried out by known methods, preferably by reacting a sulfochloride of formula (II) with an amine of formula (III) in the presence of a base. The amine of formula (III) as a base or as a salt formed with an acid is dissolved in an appropriate solvent (for example chlorinated hydrocarbons, hydrocarbons, tetrahydrofuran, dimethylformamide or acetonitrile), base is added (for example triethylamine) followed by the appropriate sulfochloride. The reaction is carried out preferably between –10°C and ambient temperature. The reactions are followed by thin layer chromatography. The necessary reaction time is about 6-24 h. The work-up of the reaction mixture can be carried out by different methods. The products can be purified for example by crystallization or, if necessary, by column chromatography.

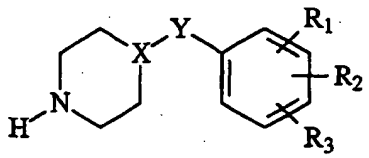
Those having skill in the art can recognize that the starting materials may be varied and additional steps can be employed to produce compounds encompassed by the present invention, as demonstrated by the Examples. In some cases protection of certain reactive functionalities may be necessary to achieve some of the above transformations. In general the need for such protecting groups is

apparent to those skilled in the art as well as the conditions necessary to attach and remove such groups.

The structures of all intermediates and end products were elucidated by IR, NMR and mass spectroscopy.

The sulfochlorides of formula (II) are either commercially available or can be synthesized by different known methods, *e.g.* J.Chem.Soc., **1992**, 4889-4898; J.Med.Chem., **1989**, 32, 2436-2442; J.Med.Chem., **1993**, 36, 320-330.

The amines of formula (III) may be prepared by alkylation of compounds of formula (IV) or a derivative thereof



(IV)

- wherein the meaning of R_1, R_2, R_3, X and Y are as described above for formula (I), by known methods: *e.g.* J.Med.Chem., **2000**, 43, 1878-1885.

The amines of formula (IV) are either commercially available or can be synthesized by different known methods: *e.g.* where X stands for CH and Y stands for NH group: Synlett, **1961**, 537; where X stands for CH and Y stands for oxygen or OCH_2: J.Med.Chem., **1974**, 17, 1000; where X stands for CH and Y stands for CH_2 group: US 3,632,767; WO 97/23216; FR 2,534,580; where Y is a bond and X stands for nitrogen: Tetrahedron, **1999**, 55, 13285-13300; J.Med.Chem., **1989**, 32, 1052-1056; US 2,922,788.

The separation of *cis*- and *trans*-isomers either of compounds of formula (I) or of formula (III) or the protected derivatives of the latter is carried out by conventional methods, *e.g.* by chromatography and/or crystallization, or the *cis*- or *trans*-isomers of formula (III) can be prepared using pure *cis*- or *trans*-isomers as an alkylating agents.

The obtained derivatives of formula (I) can be transformed into an other compound of formula (I) in given case by introducing further substituent(s) and/or modifying and/or removing the existing one(s). For example cleaving the methyl group from a methoxy group which stands for R_1 and/or R_2 and/or R_3 leads to phenol derivatives. The cleavage of methyl group can be carried out for example

with boron tribromide in dichloromethane. The compounds of formula (I) containing cyano groups can be for example transformed to amides by hydrolysing them with hydrogenperoxide in dimethylsulfoxide, or to amidines by reacting them first with gaseous hydrogenchloride in ether, then by reacting the iminoester obtained with ammonia, *etc.*

The sulfonamide derivatives of formula (I) can also be prepared on solid support:

i) A compound of formula (VI) wherein R_6 represents hydrogen or a protecting group *e.g.* silyl or tetrahydropyranyl was attached to a polystyrene resin of formula (V), wherein R_4 and R_5 can be the same or different and represent hydrogen or methoxy group with the exception R_4=R_5=H, by reductive amination with a reducing agent *e.g.* $NaB(OAc)_3H$ or $NaBH_3CN$;

ii) halogenation, preferably bromination, of the terminal hydroxy group of a compound of formula (VII), wherein the meaning of R_6 is as described above for formula (VI), with a halogenation agent *e.g.* PPh_3Br_2, PPh_3I_2, or if it was protected, the protecting group had been removed before the halogenation, which results a solid phase compound of formula (VIII) wherein Z represents halogen, preferably bromide and the meaning of R_4 and R_5 is as described above for formula (V);

iii) sulfonylation a compound of formula (VIII) with different sulfochlorides of formula (II) wherein the meaning of Q is as described above for formula (I) (the first combinatorial step);

iv) alkylation with a compound of formula (IX) wherein the meaning of Z, R_4 and R_5 are as described above for the formula (VIII) and the meaning of Q is as described above for formula (I) of a secondary amine of formula (IV) wherein the meaning of R_1, R_2, R_3, X and Y are as described above for the formula (I) (the second combinatorial step);

v) releasing the products of formula (I) from the solid-phase compounds of formula (X) wherein the meaning of Q, R_1, R_2, R_3, X and Y are as

described above for the formula (I) and of R_4 and R_5 are as described above for the formula (V) by acidic cleavage.

This synthetic route is represented by Figure 1.

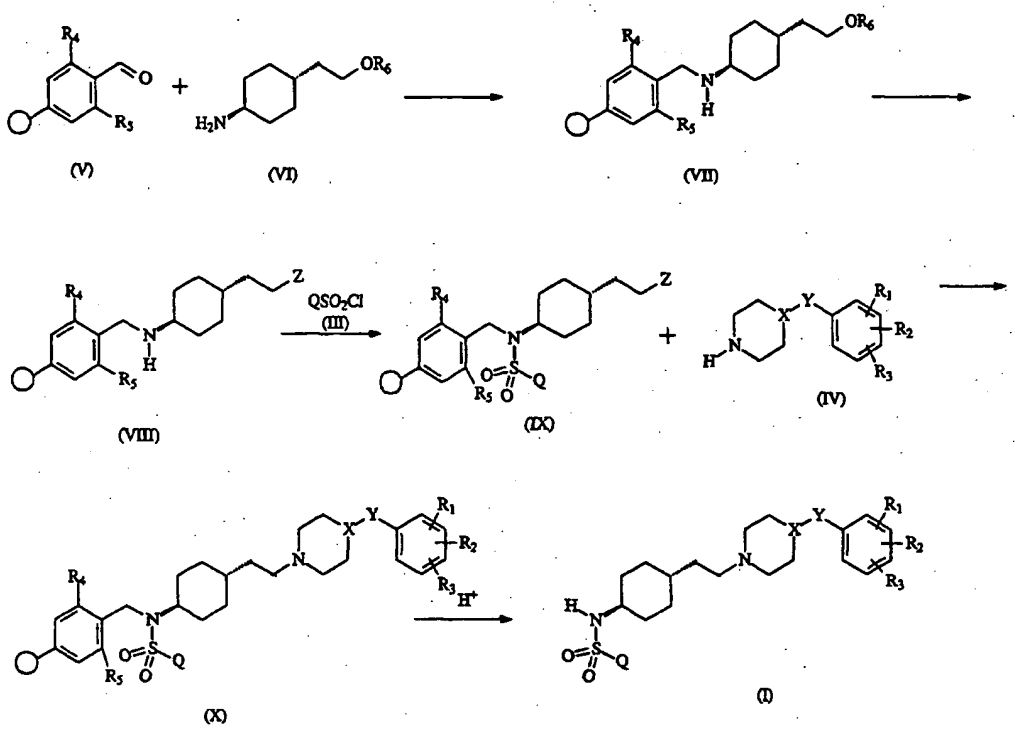


Figure 1

The invention also relates to the pharmaceutical compositions containing the compounds of formula (I) as active ingredient.

The compounds of formula (I) of the present invention have been found to exhibit affinity for dopamine receptors, in particular the D_3 receptor, and are expected to be useful in the treatment of disease states which require modulation of such receptors, *e.g.* psychotic or ophthalmological disorders. The compounds of formula (I) have been found to have greater affinity for dopamine D_3 than for D_2 receptors. The compounds of formula (I) may therefore advantageously be used as selective modulators of D_3 receptors.

Dysfunction of the dopaminergic neurotransmitter system is involved in the pathology of several neuropsychiatric disorders such as schizophrenia, Parkinson's

disease and drug abuse. The effect of dopamine is mediated via at least five distinct dopamine receptors belonging to the D_1- (D_1, D_5) or the D_2- (D_2, D_3, D_4) families. D_3 receptors have been shown to have characteristic distribution in the cerebral dopaminergic systems. Namely, high densities were found in certain limbic structures such as nucleus accumbens and islands of Calleja. Therefore, selective targeting of the D_3 receptors may be a promising approach for more selective modulation of dopaminergic functions and consequently for successful therapeutic intervention in several abnormalities, such as schizophrenia, emotional or cognitive dysfunctions and addiction (Sokoloff, P. et al: Nature, **1990,** 347, 146; Schwartz, J.-C. et al.: Clin. Neuropharmacol., **1993,** 16, 295; Levant, B.: Pharmacol. Rev., **1997,** 49, 231.), addiction (Pilla, C. et al: Nature, **1999,** 400, 371) and Parkinson's disease (Levant, B. et al.: CNS Drugs, **1999,** 12, 391) or pain (Levant, B. et al.: Neurosci. Lett., **2001,** 303, 9). Dopamine D_3 receptors are also implicated in regulation of intraocular pressure and agonists at these receptors are capable of decreasing the intraocular pressure (Chu, E. et al: J. Pharmacol. Exp. Ther., **2000,** 292, 710), thus D_3 receptors agonists can be useful for the treatment of glaucoma.

Certain compounds of formula (I) have been found to be dopamine D_3 receptor antagonist, others may be agonists or partial agonists.

In a further aspect of the present invention provides a method of treating conditions which require modulation of dopamine D_3 receptors, for example psychoses, for example in the treatment of schizophrenia, schizo-affective disorders, psychotic depression, mania, paranoid and delusional disorders, dyskinetic disorders such as Parkinson's disease, neuroleptic induced parkinsonism, depression, anxiety, memory disorders, sexual dysfunction, drug dependency and ophthalmological disorders which comprises administering to a subject in need thereof an effective amount of a compound of formula (I) or a physiologically acceptable salt thereof.

The invention also provides the use of a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof in the

manufacture of a medicament for the treatment of conditions which require modulation of dopamine D_3 receptors.

A preferred use for D_3 agonists or partial agonists according to the present invention is in the treatment of drug abuse (such as cocaine abuse etc.) and eye diseases (such as glaucoma).

A preferred use for D_3 antagonists according to the present invention is in the treatment of schizophrenia, schizo-affective disorders, psychotic depression, mania, paranoid and delusional disorders, dyskinetic disorders such as Parkinson's disease, neuroleptic induced parkinsonism, depression, anxiety, memory disorders, sexual dysfunction, drug abuse, pain.

For use in medicine, the compounds of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof are usually administered as a standard pharmaceutical composition. The present invention therefore provides in a further aspect pharmaceutical compositions comprising a new compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof and one or more physiologically acceptable carrier(s).

The compounds of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof may be administered by any convenient method, for example by oral, parental, buccal, sublingual, nasal, rectal or transdermal administration and the pharmaceutical compositions adapted accordingly.

The compounds of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof and the physiologically acceptable salts thereof which are active when given orally can be formulated as liquids or solids, for example syrups, suspensions or emulsions, tablets, capsules and lozenges.

A liquid formulation of the compounds of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof generally consists of a suspension or solution of the compound of formula (I) or physiologically acceptable salts thereof in

a suitable liquid carrier(s) for example an aqueous solvent, such as water, ethanol or glycerine, or a non-aqueous solvent, such as polyethylene glycol or an oil. The formulation may also contain a suspending agent, preservative, flavouring or colouring agent.

A composition in the solid form of a tablet can be prepared using any suitable pharmaceutical carrier(s) routinely used for preparing solid formulations. Examples of such carriers include magnesium stearate, starch, lactose, sucrose, cellulose *etc.*

A composition in the solid form of a capsule can be prepared using routine encapsulation procedures. For example, pellets containing the active ingredient can be prepared using standard carriers and then filled into a hard gelatine capsule; alternatively, a dispersion or suspension can be prepared using any suitable pharmaceutical carrier(s), for example aqueous gums, celluloses, silicates or oils and the dispersion or suspension then filled into a soft gelatine capsule.

Typical parenteral compositions consist of a solution or suspesion of the compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof or physiologically acceptable salt thereof in a steril aqueous carrier or parenterally acceptable oil, for example polyethylene glycol, polyvinyl pyrrolidone, lecithin, arachis oil or sesame oil. Alternatively, the solution can be lyophilised and then reconstituted with a suitable solvent just prior to administration.

Compositions of the present invention for nasal administration containing a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof may conveniently be formulated as aerosols, drops, gels and powders. Aerosol formulations of the present invention typically comprise a solution or fine suspension of the compound of formula (I) in a physiologically acceptable aqueous or non-aqueous solvent and are usually presented in a single or multidose quantities in steril form is a sealed container, which can take the form of a cartridge or refill for use with an atomising device. Alternatively, the sealed container may be a unitary dispensing device, such as a single dose nasal inhaler or an aerosol dispenser fitted with a metering valve which is intended for disposal once the contents of the container have been exhausted. Where the dosage form comprises

an aerosol dispenser, it will contain a propellant which can be a compressed gas, such as compressed air or an organic propellant, such as a fluorochlorohydrocarbon. The aerosol dosages form can also take the form af a pump-atomiser. Compositions of the present invention containing a compound of formula (I) suitable for buccal or sublingual administration include tablets, lozenges and pastilles, wherein the active ingredient is formulated with a carrier, such as sugar and acacia, tragacanth, or gelatine and glycerin etc.

Compositions of the present invention containing a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof for rectal administration are conveniently in the form of suppositories containing a conventional supposiory base, such as cocoa butter.

Compositions of the present invention containing a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof for transdermal administration include ointments, gels and patches.

The compositions of the present invention containing a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof is preferably in the unit dose form, such as tablet, capsule or ampoule.

Each dosage unit of the present invention for oral administration contains preferably from 1 to 250 mg of a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof calculated as a free base.

Each dosage unit of the present invention for parenteral administration contains preferably from 0.1 to 25 mg of a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof calculated as a free base.

The physiologically acceptable compounds formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof can normally be administered in a daily dosage regimen (for an adult patient) of, for example, an oral

dose between 1 mg and 500 mg, preferably between 10 mg and 400 mg, e.g. between 10 and 250 mg or an intravenous, subcutaneous, or intramuscular dose of between 0.1 mg and 100 mg, preferably between 0.1 mg and 50 mg, e.g. between 1 and 25 mg of the compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof calculated as the free base. The compound of the present invention can be administered 1 to 4 times per day. The compound of the present invention can suitably be administered for a period of continous therapy, for example for a week or more.

Receptor binding assays

1. D_3 receptor binding

Binding study was carried out on rat recombinant D_3 receptors expressed in Sf9 cells using [^{3}H]-spiperone (0.4 nM) as ligand and haloperidol (10μM) for determination of non-specific binding. The assay was performed according to Research Biochemical International assay protocol for rD_3 receptor (Cat. No. D-181).

2. D_2 receptor binding

Binding of [^{3}H]-spiperone (0.5 nM) to rat striatal tissue was measured according to the method of Seeman (J. Neurochem., **1984**, 43 221-235). The non-specific binding was determined in the presence of (±)-sulpiride (10μM).

D_3 and D_2 receptor binding data of compounds of the present invention are listed in Table 1.

code	D3-IC_{50} (nM)	D2-IC_{50} (nM)
70001485	5,5	2586
70001488	4,3	245
70001492	2,0	65
70001588	2,5	102
70001589	3,0	16
70001596	0,6	110
70001766	5,3	128
70001788	1,5	290
70001934	1,0	109
70001935	0,3	29
70001686	3,9	345
70001875	2,8	66

Table 1

The most prominent side effects of the first generation antipsychotic compounds (*e.g.* chlorpromazine and haloperidol) with preferential blockade at dopamine D_2, and alpha-1 receptors, are the tardive dyskinesia and orthostatic hypotension. The former one is the result of blockade of D_2 receptors in the basal ganglia whereas the latter is the consequence of antagonism of alpha-1 receptors.

Compounds in Table 1 are potent ligands at D_3 receptors (IC-50 values are between 0.3 and 5.5 nM) and show 5 to 470 fold selectivity over D_2 receptors. Moreover, the compounds have beneficial profile in terms of potency on D_3 receptors and selectivity towards D_2. It is therefore anticipated that no or greatly diminished adverse effects related to D_2 receptors will occur in the course of therapeutical application of compounds of the present invention.

The invention is further illustrated by the following non-limiting examples.

Example 1

1-(3-cyano-5-trifluoromethyl-phenyl)-piperazine

2.42 g (13 mmol) 3-fluoro-5-trifluoromethyl-benzonitrile and 6.0 g (70 mmol) piperazine was dissolved in 50 ml dimethylsulfoxide and the solution was refluxed for one day. The mixture was poured into 200 ml of water and extracted with diethylether (3 x 100 ml). The organic layers were washed with saturated sodium

chloride solution, then dried and evaporated to dryness in vacuo giving 2.96 g (yield 89.2 %) of the title compound, melting at 85-7 °C.

Example 1

***Trans*-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-carbamic acid *tert*-butyl ester**

0.63 g (2.5 mmol) of 1-(3-cyano-5-trifluoromethyl-phenyl)-piperazine and 0.6 g (2.5 mmol) of *trans*-2-{1-[4-(N-tert-butyloxycarbonyl)amino]cyclohexyl}-acetaldehyde were dissolved in dichloroethane (35 ml), 0.79 g (3.7 mmol) sodium triacetoxyborohydride was added portionswise and the reaction mixture was stirred for 20 hours at ambient temperature, then 20 % potassium carbonate solution in water (20 ml) was added. The organic layer was separated, dried and evaporated to dryness in vacuo. The precipitate was recrystallized from acetonitrile to give the title compound 1.03 g (yield 85.8 %), m.p.: 139-140 °C.

The following compounds were prepared in a similar manner to Example 1:

Trans-(4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 171-2 °C

Trans-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 130-2 °C

Trans-(4-{2-[4-(2,3-dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 144-5°C

Trans-(4-{2-[4-(3-trifluoromethyl-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 107 °C

Trans-(4-{2-[4-(3-fluoro-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)- carbamic acid tert-butyl ester, m.p.: 128 °C

Trans-(4-{2-[4-(3-cyano-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)- carbamic acid tert-butyl ester, m.p.: 115-6 °C

Trans-(4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 112-3 °C

Trans-(4-{2-[4-(3-trifluoromethyl-phenylmethoxy)-piperidin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 107 °C

Trans-(4-{2-[4-(3-trifluoromethyl-phenoxy)-piperidin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester, m.p.: 118-9 °C

Example 2

***Trans*-3-{4-[2-(4-amino-cyclohexyl)-ethyl]-piperazin-1-yl}-5-trifluoromethyl-benzonitrile**

1.03 g (2.1 mmol) *trans*-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-carbamic acid tert-butyl ester was deprotected at 10 °C using 10 ml ethylacetate saturated with gaseous hydrochloric acid, the precipitate was filtered giving 0.94 g (yield 98 %) dihydrochloride salt of the title compound, melting above 260 °C.

The following compounds were prepared in a similar manner to Example 2:

Trans-4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: > 280 °C

Trans-4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 280 °C

Trans-4-{2-[4-(2,3-dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 264-5 °C

Trans-4-{2-[4-(3-trifluoromethyl-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 268 °C

Trans-4-{2-[4-(3-fluoro-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 286-7 °C

Trans-4-{2-[4-(3-cyano-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 257-8 °C

Trans-4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 260-4 °C

Trans-4-{2-[4-(3-trifluoromethyl-phenylmethoxy)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 262 °C

Trans-4-{2-[4-(3-trifluoromethyl-phenoxy)-piperidin-1-yl]-ethyl}-cyclohexylamine dihydrochloride, m.p.: 294 °C

Example 3

***Trans*-N-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-pyridine-3-sulfonamide (70001503)**

0.38 g (1 mmol) of *trans*-3-{4-[2-(4-amino-cyclohexyl)-ethyl]-piperazin-1-yl}-5-trifluoromethyl-benzonitrile was dissolved in dichloromethane (30 ml), 0.42 ml (3 mmol) triethylamine was then added followed by 0.24 g (1.1 mmol) of pyridine-3-sulfochloride hydrochloride.The mixture was stirred for 24 hours, washed twice with 10 % sodium bicarbonate solution, dried and evaporated to dryness in vacuo. The residue was purified on silica gel eluting with 10% ethanol/chloroform, then converted to the dihydrochloride salt of the title compound. 0.32 g (yield 54 %), melting at 194-5 °C.

The following compounds were prepared in a similar manner to Example 3:

Trans-N'-(4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexyl)-N,N-dimethyl-sulfamide hydrochloride, m.p.: 243-6 °C (70001488)

Trans-4-chloro-N-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide hydrochloride, m.p.: 260-2 °C (70001492)

Trans-4-chloro-N-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide hydrochloride, m.p.: 223 °C (70001552)

Trans-N-(4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 219 °C (70001737)

Trans-5-chloro-N-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]]-ethyl}-cyclohexyl)-2-thiophenesulfonamide hydrochloride, m.p.: 181 °C (70001766)

Trans-N'-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-N,N-dimethyl-sulfamide, m.p.: 83-5 °C (70001788)

Trans-N-(4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexyl)-buthanesulfonamide hydrochloride, m.p.: 215-8 °C (70001485)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-buthanesulfonamide hydrochloride, m.p.: 228-9 °C (70001596)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-morpholinepropanesulfonamide dihydrochloride, m.p.: 218-20 °C (70001934)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 183-6 °C (70001935)

Trans-N-(4-{2-[4-(2,3-dichloromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 272-4 °C (70002127)

Trans-4-bromo-N-(4-{2-[4-(3-trifluoromethyl-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide, m.p.: 145 °C (70001539)

Trans-4-chloro-N-(4-{2-[4-(3-fluoro-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide, m.p.: 109 °C (70001686)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 102 °C (70002060)

Trans-4-chloro-N-(4-{2-[4-(3-trifluoromethyl-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide, m.p.: 150-1 °C (70001317)

Trans-4-chloro-N-(4-{2-[4-(3-cyano-phenylmethyl)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide hydrochloride, m.p.: 101 °C (70001775)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-trifluoroethanesulfonamide hydrochloride, m.p.: 198 °C (70001595)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-buthanesulfonamide hydrochloride, m.p.: 198 °C (70001588)

Trans-4-chloro-N-(4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide hydrochloride, m.p.: 237-9°C (70001589)

Trans-N'-(4-{2-[4-(3-trifluoromethyl-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-N,N-dimethylsulfamide hydrochloride, m.p.: 169-71°C (70001590)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenylmethoxy)-piperidin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 73 °C (70001873)

Trans-N-(4-{2-[4-(3-trifluoromethyl-phenoxy)-piperidin-1-yl]-ethyl}-cyclohexyl)-3-pyridinesulfonamide dihydrochloride, m.p.: 98 °C (70001875)

Example 4

Trans-N-{4-[2-[4-(3-aminocarbonyl-5-trifluoromethyl-phenyl)-1-piperizinyl]-ethyl]-cyclohexyl}-3-pyridinesulfonamide (70002080)

0.37 g (0.7 mmol) of *trans*-N-(4-{2-[4-(3-cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-pyridine-3-sulfonamide was dissolved in 2 ml

dimethylsulfoxide, 80 mg K_2CO_3 was added and 0.15 ml of 30 % H_2O_2 was dropped in while keeping the temperature at 20 ^{0}C. After stirring for 2 h 20 ml of water was added, the precipitate filtered, washed with water giving the title compound, melting point:191°C (0.2 g; 53 %).

Example 5

Polymer-bound *trans*-2-(4-amino-cyclohexyl)-ethanol

5 g of 2-(4-formyl-3-methoxy)phenoxyethyl polystyrene (1.12 mmol/g) resin was suspended in 150 ml of dichloromethane. To the shaken suspension 3.5 g (4.5 eq.) of *trans*-2-(4-amino-cyclohexyl)-ethanol was added, followed by dropwise addition of 4.5 ml of acetic acid. 1.2 g (1 eq) of $NaBH(OAc)_3$ was added in portions within 15 minutes. After 3 hours of shaking another 0.6 g (0.5 eq.) of $NaBH(OAc)_3$ was added in one portion. The shaking was continued overnight. The mixture was filtered and the resin was washed in sequence with the following solvents (100 ml, twice with each): dichloromethane, methanol, 10% triethylamine in dimethylformamide, methanol, dimethylformamide, tetrahydrofuran, diethylether.

Example 6

Polymer-bound *trans*-2-(4-amino-cyclohexyl)-ethylbromide

The freshly prepared mixture of 1.45 g (5 eq.) triphenylphosphine and 0.28 ml (5 eq.) Br_2 in 20 ml of dichloromethane was added to 1 g of the polymer-bound *trans*-2-(4-amino-cyclohexyl)-ethanol and 0.38 g (5 eq.) 1-*H*-imidazole. The suspension was shaken for 18 hours, filtered and the resin was washed in sequence with the following solvents (20 ml, twice with each): dichloromethane, methanol, 10% triethylamine in dimethylformamide, methanol, dimethylformamide, tetrahydrofuran, diethylether.

Example 7

Polymer-bound *trans*-4-bromo-N-[4-(2-bromo-ethyl)-cyclohexyl]-benzenesulfonamide

To 0.1 g of polymer-bound *trans*-2-(4-amino-cyclohexyl)-ethylbromide in 2.5 ml of tetrahydrofuran 10 mg dimethylaminopyridine, 0.07 ml (5 eq.) triethylamine and 0.13 g (5 eq.) 4-bromobenzenesulfochloride were added. The mixture was shaken for 18 hours, filtered and the resin was washed in sequence with the following solvents (10 ml, twice with each): tetrahydrofuran, methanol, tetrahydrofuran, dimethylformamide, methanol, dichloromethane, methanol, dimethylformamide.

Example 8

Polymer-bound *trans*-4-bromo-N-(4-{2-[4-(2-methoxy-phenyl)-piperazin-1-yl] -ethyl}-cyclohexyl)-benzenesulfonamide

To the polymer-bound *trans*-4-N-[4-(2-bromo-ethyl)-cyclohexyl]-benzenesulfonamide in 2 ml dimethylformamide 65 mg (5 eq.) 1-(2-methoxyphenyl)-piperazine and 0.065 ml (5 eq.) diisopropylethylamine were added and the mixture was shaken for 18 hours at 90 °C. The resin was filtered and washed in sequence with the following solvents (10 ml, twice with each): dimethylformamide, methanol, dimethylformamide, methanol, dimethylformamide, methanol, dichloromethane.

Example 9

***Trans*-4-bromo-N-(4-{2-[4-(2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide**

The product was cleaved from the resin with shaking in 2 ml of 10% TFA in dichloromethane for two hours. The mixture was filtered and washed with the following solvents (10 ml, twice with each): dichloromethane, methanol, dichloromethane, and methanol. The filtrate was evaporated in vacuo to give the title product.

The LC/MS analysis were performed using an HP 1100 binary gradient system, controlled by ChemStation software. HP diode array detector was used to acquire UV spectra at λ = 240 nm. Analytical chromatographic experiments were made on Discovery C_{16}-Amide, 5 cm X 4.6 mm X 5 µm column with a flow rate of 1 ml/min for qualification (purity, capacity factor). All experiments were performed

using HP MSD single quadruple mass spectrometer equipped with an electrospray ionisation source to determine the structure.

[$k' = t_R - t_0 / t_0$ t_R = retention time

t_0 = eluent retention time]

k'= capacity factor

The following compounds in Table 2 were prepared in a similar manner to Example 5-9:

ID	NAME	MW	MS found MW	k'
80001076	2,5-Dichloro-N-(4-{2-[4-(3-trifluoromethyl-phenoxy)-piperidin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide	579,5	580,4	4,272
80001099	N-(4-{2-[4-(3-Bromo-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-4-methoxy-benzenesulfonamide	550,6	551,4	3,842
80001109	4-Chloro-N-(4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide	530,0	530,5	3,986
80001110	N-(4-{2-[4-(2-Methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-nitro-benzenesulfonamide	502,6	503,5	3,545
80001121	N-(4-{2-[4-(2,3-Dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-2-nitro-benzenesulfonamide	541,5	542,5	3,942
80001137	N-(4-{2-[4-(3-Cyano-5-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-fluoro-benzenesulfonamide	538,6	539,5	3,859
80001138	N-[4-(4-{2-[4-(4-Bromo-2,3-dimethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexylsulfamoyl)-phenyl]-acetamide	591,6	592,5	3,808
80001139	N-(4-{2-[4-(3-Bromo-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-2,4,6-trimethyl-benzenesulfonamide	548,6	549,5	4,036
80001141	Biphenyl-4-sulfonic acid (4-{2-[4-(4-bromo-2-ethoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-amide	626,7	627,6	4,269
80001153	N-(4-{2-[4-(2,5-Dichloro-phenylamino)-piperidin-1-yl]-ethyl}-cyclohexyl)-4-nitro-benzenesulfonamide	555,5	556,5	4,015
80001168	Biphenyl-4-sulfonic acid (4-{2-[4-(5-chloro-2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-amide	568,2	568,6	4,104
80001171	N-(4-{2-[4-(3-Chloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methoxy-benzenesulfonamide	492,1	492,2	3,631
80001181	N-(4-{2-[4-(3,5-Dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methyl-benzenesulfonamide	510,5	511,5	3,939
80001187	N-(4-{2-[4-(4-Chloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methoxy-benzenesulfonamide	492,1	493,1	3,598
80001196	N-(4-{2-[4-(4-Bromo-2-ethoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-iodo-benzenesulfonamide	676,4	677,5	4,032
80001210	3,4-Dichloro-N-(4-{2-[4-(3-methoxy-biphenyl-4-yl)-piperazin-1-yl]-ethyl}-cyclohexyl)-benzenesulfonamide	602,6	603,5	4,230
80001226	Quinoline-8-sulfonic acid (4-{2-[4-(3-trifluoromethyl-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-amide	546,7	547,6	3,725
80001233	N-[4-(4-{2-[4-(3,5-Dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexylsulfamoyl)-phenyl]-acetamide	553,5	554,5	3,555

Table 2 is continued on the next page

continued from the previous page

80001238	N-(4-{2-[4-(5-Chloro-2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-fluoro-benzenesulfonamid	510,1	510,5	3,521
80001239	N-[4-(4-{2-[4-(3-Chloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexylsulfamoyl)-phenyl]-acetamide	519,1	519,6	3,273
80001252	Biphenyl-4-sulfonic acid (4-{2-[4-(2-fluoro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-amide	521,7	522,6	3,985
80001255	N-(4-{2-[4-(2-Fluoro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methoxy-benzenesulfonamide	475,6	476,6	3,325
80001262	N-(4-{2-[4-(2-Fluoro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methyl-benzenesulfonamide	459,6	460,5	3,476
80001264	N-(4-{2-[4-(5-Chloro-2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3-trifluoromethyl-benzenesulfonamide	560,1	560,5	3,804
80001271	N-(4-{2-[4-(4-Chloro-2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3,4-dimethoxy-benzenesulfonamide	552,1	552,6	3,374
80001276	N-(4-{2-[4-(2-Fluoro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3-nitro-benzenesulfonamide	490,6	491,5	3,442
80001280	N-(4-{2-[4-(2,3-Dichloro-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-3,4-dimethoxy-benzenesulfonamide	556,5	557,5	3,713
80001294	N-(4-{2-[4-(4-Chloro-2-methoxy-phenyl)-piperazin-1-yl]-ethyl}-cyclohexyl)-4-methyl-benzenesulfonamide	506,1	506,5	3,698

Table 2

Example 10

Pharmaceutical formulation

a) Intravenous injection

Compound of formula (I)	1-40 mg
Buffer	to pH ca 7
Solvent/complexing agent	to 100 ml

b) Bolus injenction

Compound of formula (I)	1-40 mg
Buffer	to pH ca 7
Co-solvent	to 5 ml

Buffer: suitable buffers include *e.g.* citrate, phosphate, sodium hydroxide/hydrochloric acid.

Solvent: typically water but may also include cyclodextrins (1-100 mg) and co-solvents, such as propylene glycol, polyethylene glycol and alcohol.

c) Tablet

Compound of formula (I)	1-40 mg
Diluent/Filter(may also include cyclodextrins)	50-250 mg
Binder	5-25 mg
Disintegrant (may also include cyclodextrins)	5-50 mg
Lubricant	1-5 mg
Cyclodextrin	1-100 mg

Diluent: *e.g.* mycrocrystalline cellulose, lactose starch.

Binder: *e.g.* polyvinylpyrrolidone, hydroxypropylmethylcellulose.

Disintegrant: *e.g.* sodium starch glycolate, crospovidone.

Lubricant: *e.g.* magnesium stearate, sodium stearyl fumarate

d) Oral suspension

Compound of formula (I)	1-40 mg
Suspending agent	0.1-10 mg
Diluent	20-60 mg
Preservative	0.01-1.0 mg
Buffer	to pH ca 5-8
Co-solvent	0-40 mg
Flavour	0.01-1.0 mg
Colourant	0.001-0.1 mg

Suspending agent: *e.g.* xanthan gum, mycrocrystalline cellulose.

Diluent: *e.g.* sorbitol solution, typically water.

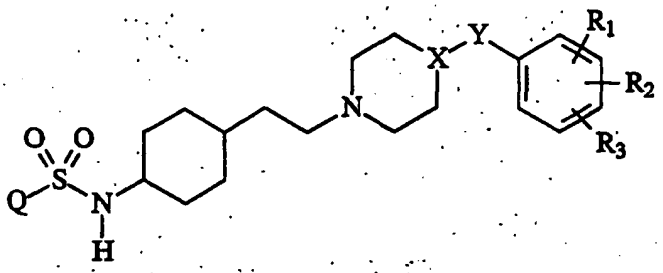
Preservative: *e.g.* sodium benzoate.

Buffer: *e.g.* citrate.

Co-solvent: *e.g.* alcohol, propylene glycol, polyethylene glycol, cyclodextrin.

What we claim:

1. A compound of formula (I)



(I)

- wherein
  - X represents a nitrogen atom or CH group;
  - Y represents a bond when X stands for nitrogen, or an oxygen atom or NH or CH_2 or OCH_2 group when X stands for CH group;
  - R_1, R_2, R_3 may be the same or different and represent independently a substituent selected from hydrogen, halogen, C_{1-6}-alkyl, C_{1-6} alkoxy, cyano, hydroxy, trifluoromethyl, C_{1-6}-alkylsulfonyloxy, trifluoromethanesulfonyloxy, C_{1-6}-alkanoyloxy, amino, alkylamino, alkanoylamino, alkylsulfonylamino, arylsulfonylamino, aminocarbonyl, carboxy, N-hydroxycarmamimidoyl, carbamimidoyl, hydroxycarbamoyl, thiocarbamoyl, sulfamoyl, mono or bicyclic heterocyclic group or optionally substituted phenyl, or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
  - Q represents an optionally substituted alkyl, aryl, aralkyl or heteroaralkyl group

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

2. A compound of formula (I) as claimed in claim 1 wherein
  - X represents a nitrogen atom or CH group;
  - Y represents a bond when X stands for nitrogen, or an oxygen atom or NH or CH_2 or OCH_2 group when X stands for CH group;

- R_1, R_2, R_3 may be the same or different and represent independently hydrogen, alkyl, alkoxy, halogen, cyano, aminocarbonyl, trifluoromethyl or optionally substituted phenyl or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
- Q represents dialkylamino, optionally substituted phenyl, biphenyl, pyridyl, thienyl, alkyl or quinolinyl

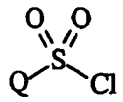
and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

3. A compound of formula (I) as claimed in claim 1 wherein

- X represents a nitrogen atom or CH group;
- Y represents a bond when X stands for nitrogen, or CH_2 group when X stands for CH group;
- R_1, R_2, R_3 may be the same or different and represent independently hydrogen, fluorine, bromine, chlorine atoms or cyano, trifluoromethyl, methyl, methoxy, ethoxy, optionally substituted phenyl or aminocarbonyl groups or two adjacent groups of R_1, R_2 and R_3 may combine to form an optionally substituted fused mono or bicyclic heterocyclic group;
- Q represents C_{1-4} alkyl, dimethylamino, biphenyl, alkylphenyl, alkoxyphenyl, halophenyl, nitrophenyl, trifluoromethylphenyl or aminocarbonylmethylphenyl, pyridyl, or quinolinyl

and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof.

4. A process for preparing compounds of formula (I) as claimed in any of claims 1-3 and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof which comprises reacting a compound of formula (II) or a derivative thereof

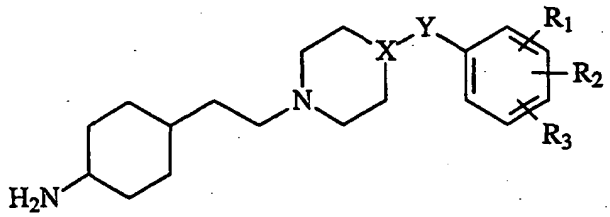


(II)

wherein

Q is as hereinbefore defined or derivatives thereof

with a compound of formula (III) or a derivative thereof



(III)

wherein

R_1, R_2, R_3, X and Y are as hereinbefore defined

and

interconverting one compound of formula (I), wherein X, Y, Q, R_1, R_2 and R_3 are as hereinbefore defined, to a different compound of formula (I), wherein X, Y, Q, R_1, R_2 and R_3 are as hereinbefore defined;

where appropriate, separation of enantiomers, and/or diastereomers and/or *cis*- and *trans*- isomers of compounds of formula (I), or intermediates thereto wherein X, Y, Q, R_1, R_2 and R_3 are as hereinbefore defined by conventional methods;

and optionally thereafter forming a salt and/or hydrate and/or solvate of formula (I), wherein X, Y, Q, R_1, R_2 and R_3 are as hereinbefore defined.

5. A process for preparing a compound of formula (I) and/or geometric isomers and/or stereoisomers and/or diastereomers and/or salts and/or hydrates and/or solvates thereof as defined in any of claims 1 to 3 which comprises preparing a compound of formula (I) on solid support.

6. A process as claimed in claim 5 which comprises

i) a compound of formula (VI), wherein R_6 represents hydrogen or a protecting group, was attached to a polystyrene resin of formula (V), wherein R_4 and R_5 can be the same or different and represent hydrogen or methoxy group with the exception R_4=R_5=H, by reductive amination with a reducing agent;

ii) halogenation, preferably bromination, of the terminal hydroxy group of a compound of formula (VII), wherein the meaning of R_6 is as described above for formula (VI), with a halogenation agent, or if it was protected, the protecting group had been removed before the halogenation, which results a solid phase compound of formula (VIII) wherein Z represents halogen and the meaning of R_4 and R_5 is as described above for formula (V);

iii) sulfonylation a compound of formula (VIII) with a sulfochloride of formula (II) wherein the meaning of Q is as described above for formula (I);

iv) alkylation with a compound of formula (IX) wherein the meaning of Z, R_4 and R_5 are as described above for the formula (VIII) and the meaning of Q is as described above for formula (I) of a secondary amine of formula (IV) wherein the meaning of R_1, R_2, R_3, X and Y are as described above for the formula (I);

v) releasing the products of formula (I) from the solid-phase compound of formula (X) wherein the meaning of Q, R_1, R_2, R_3, R_4, R_5, X and Y are as described above for the formula (I) by acidic cleavage.

7. A pharmaceutical composition comprising a compound of formula (I) as claimed in any of claims 1-3 and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof and one or more physiologically acceptable carrier(s).

8. The use of a compound of formula (I) as claimed in any of claims 1-3 and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof in the

manufacture of a medicament for the treatment and/or prevention of a condition which requires modulation of a dopamine receptor.

9. Use according to claim 8 wherein the dopamine receptor is a dopamine D_3 receptor.

10. A method of treating and/or preventing a condition which requires modulation of a dopamine receptor which comprises administering to a subject in need thereof an effective amount of a compound of formula (I) as claimed in any of claims 1-3 and/or geometric isomers and/or stereoisomers and/or diastereomers and/or physiologically acceptable salts and/or hydrates and/or solvates thereof.

11. A method of treating and/or preventing a condition as claimed in claim 10 wherein the dopamine receptor is a dopamine D_3 receptor.

INTERNATIONAL SEARCH REPORT

Inten al Application No
PCT/HU 02/00093

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C07D295/12 A61K31/445 A61K31/495

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, CHEM ABS Data, BEILSTEIN Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 779 284 A (BIOPROJET SOC CIV ;INST NAT SANTE RECH MED (FR)) 18 June 1997 (1997-06-18) claims; examples	1-11
A	WO 93 21179 A (ASTRA AB) 28 October 1993 (1993-10-28) claims; examples	1-11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November 2002	20/11/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Menegaki, F

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GLASE S A ET AL: "4-bromo-1-methoxy-N-'2-(4-aryl-1-piperazinyl)ethyl!-2-naphthalenecarb oxamide s: selective dopamine D3 receptor partial agonists" BIOORGANIC & MEDICINAL CHEMISTRY LETTERS, OXFORD, GB, vol. 6, no. 12, 18 June 1996 (1996-06-18), pages 1361-1366, XP004134841 ISSN: 0960-894X figure 2; tables 1-3	1-11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/HU 02/00093

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

Although claims 10,11 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

...rmation on patent family members

Intern ...l Application No
PCT/HU 02/00093

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0779284 A	18-06-1997	FR 2742149 A1	13-06-1997
		AT 220399 T	15-07-2002
		CA 2192535 A1	12-06-1997
		DE 69622246 D1	14-08-2002
		DE 69622246 T2	07-11-2002
		DK 779284 T3	07-10-2002
		EP 0779284 A1	18-06-1997
		JP 9291033 A	11-11-1997
		US 5985895 A	16-11-1999
		US 5872119 A	16-02-1999
WO 9321179 A	28-10-1993	AU 3964393 A	18-11-1993
		BG 98281 A	30-09-1994
		CA 2109816 A1	28-10-1993
		CZ 9302701 A3	17-08-1994
		EP 0594813 A1	04-05-1994
		FI 935494 A	08-12-1993
		HU 68891 A2	28-08-1995
		JP 6508378 T	22-09-1994
		NO 934426 A ,B,	06-12-1993
		WO 9321179 A1	28-10-1993
		SI 9300191 A	31-12-1993
		SK 138993 A3	09-11-1994